(12) UK Patent Application (19) GB (11) 2 052 765 A

(21) Application No 8017516
(22) Date of filing 29 May 1980
(30) Priority data
(31) 2922535
(32) 1 Jun 1979
(33) Fed. Rep. of Germany (DE)
(43) Application published 28 Jan 1981
(51) INT CL³ G01M 5/00 // 19/00 G01N 3/34 3/36
(52) Domestic classification G1S 1A 1C 1E1 1E2A 1F 1G 1R 4G
(56) Documents cited
GB 1357679
GB 1264752
GB 1019378
(58) Field of search G1S
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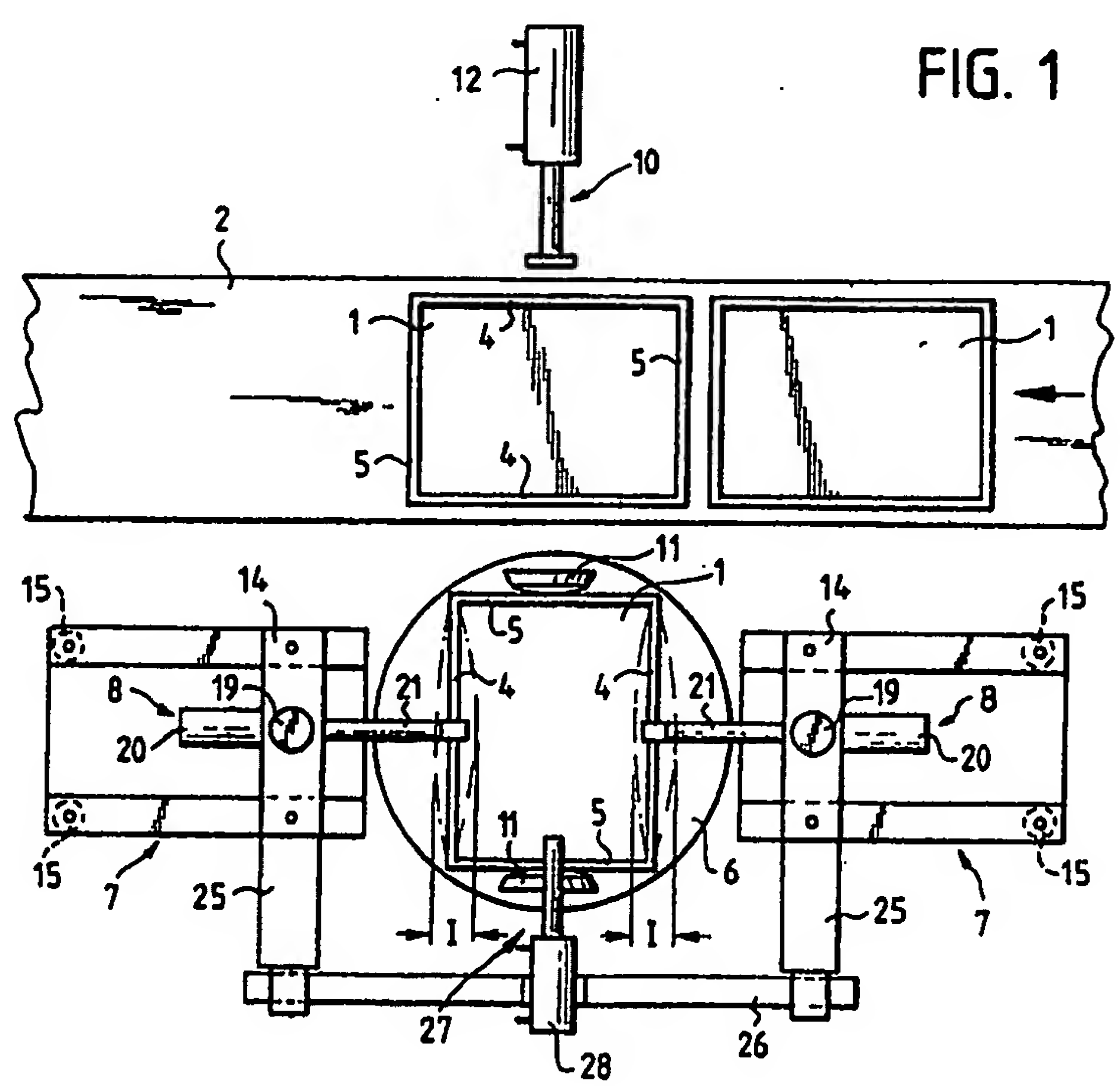
(54) Determining the strength of plastics crates

(57) An installation for determining whether plastics crates 1 having integral handles 4, 5, have become embrittled by ageing processes, comprises a conveyor 2 a rotatable table 6 onto which crates to be tested are moved by a pusher 10. The method of testing comprises clamping the crates in position on the table by means of piston rods 24 and operating a pair of bending force generators 8 comprising hydraulic rams 20 and piston rods 21 with forked ends 22 which grip the handles 4 and bend them to and fro. If the handles break the crate is moved off the table and away from the conveyor by a pusher 27, but if the handles remain intact the crate is returned to service by rotating the table 6 so that the pusher 27 may move the crate back onto the conveyor. The crate may however be subjected to torsional forces or hammer blows.

FIG. 1



The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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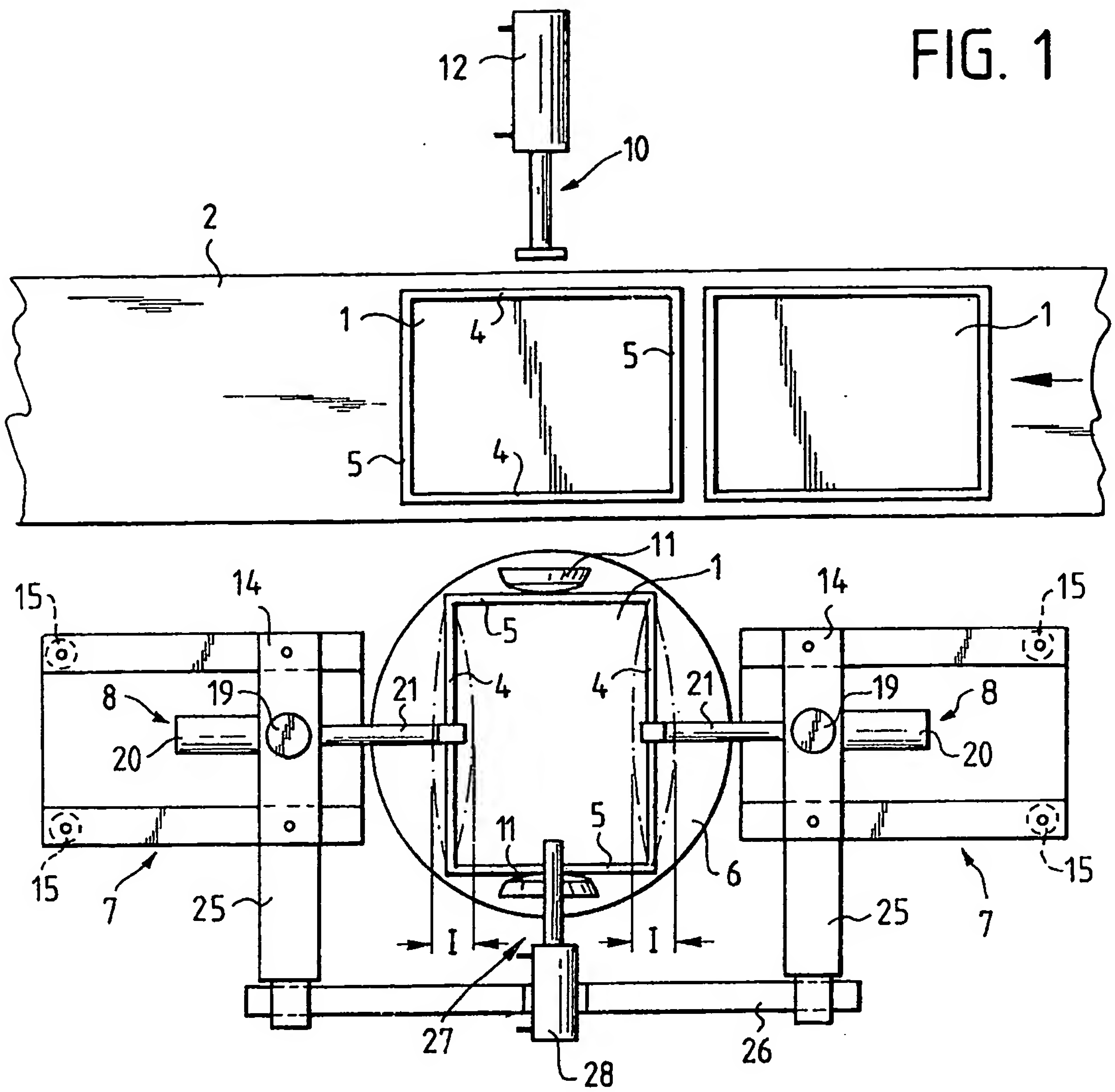

FIG. 1

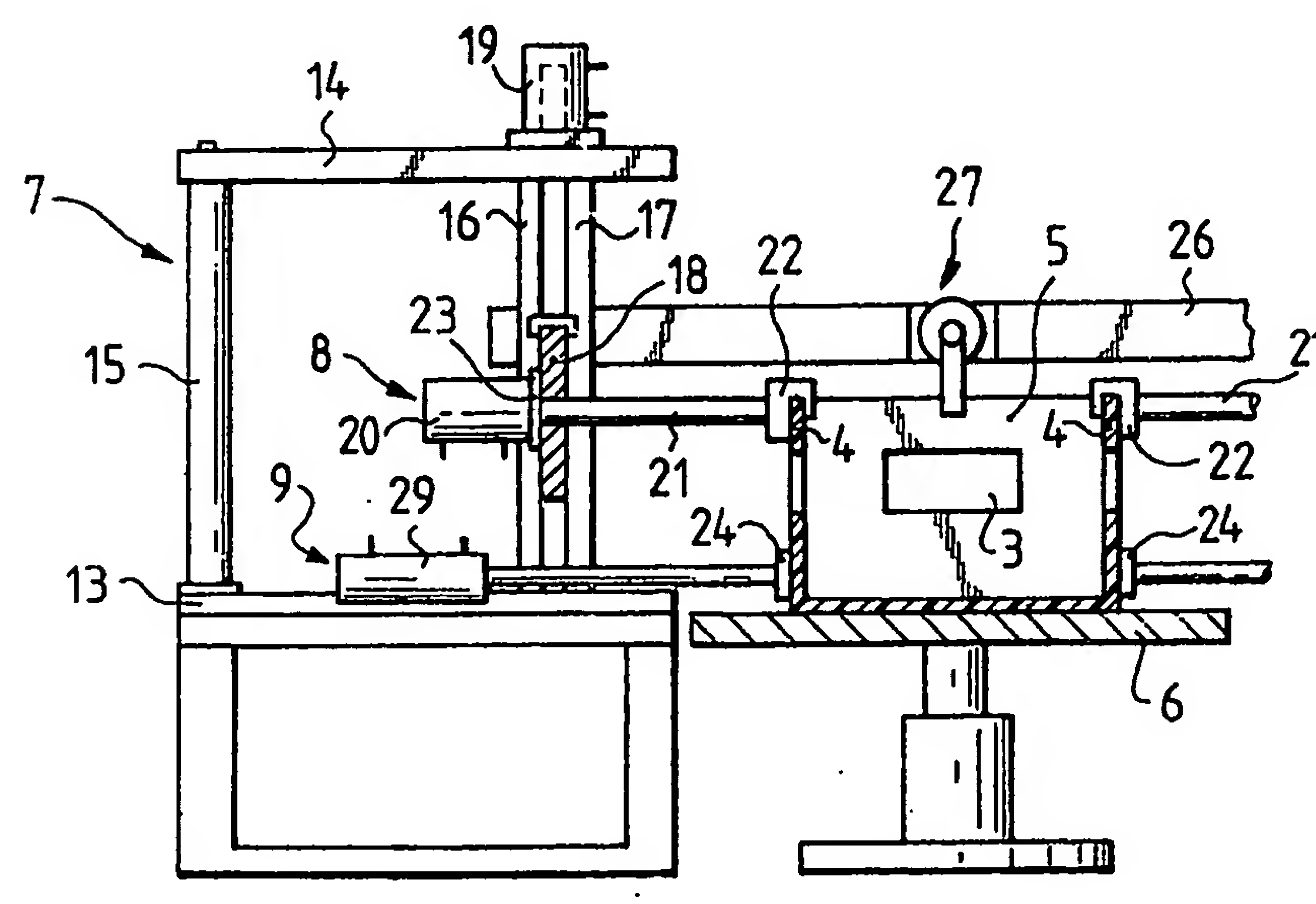

FIG. 2

SPECIFICATION

Method of determining the strength of plastics crates

This invention relates to a method of determining the strength of plastics crates, particularly those which have handles.

Like other plastics objects, bottle crates made of plastics are subject to ageing processes in which their strength deteriorates in the course of time as a result of embrittlement, making them liable to breakage. Bottle crates must have a certain strength to comply with accident prevention requirements. These requirements have existed for many years in some countries, but until now, the only practical solution to this problem has been to stamp the date of manufacture on the crates and withdraw them from circulation after a fixed working life. This method is unreliable as the factors which cause embrittlement, such as ultra violet radiation, may be subject to wide variations. Moreover this solution is wasteful since after the appropriate time interval, those crates which have been subjected to favourable conditions, and so still have a useful life, are discarded along with the defective crates.

In order to determine the ageing of plastics it is known to load a flat strip, clamped at one side, to breaking point, and to note the load and the angle of bending ("Plastics", Vol. 60, 1970, No. 11, pages 889 and 890). A large bending angle of a particular weathered strip indicates a low sensitivity of the plastics to ageing.

As permanent chemical changes, in particular degradation processes in the presence of oxygen, are responsible for the ageing of plastics, the sensitivity of plastics to ageing has also been determined by observing the oxygen reduction in a closed system including the plastics test piece, which may be in the form of a sheet for example. (See West German Auslegeschrift No. 1 598 811).

These known methods give a characteristic value for a given platics. However this value is obtained for an idealised test specimen, namely, as explained, a flat strip or a sheet. In contrast to this, the ageing characteristics can vary widely between plastics bottle crates. In addition, the strength and sensitivity to ageing can depart significantly from those which one would be led to expect from standard data or from leaflets giving the characteristics value for a particular plastics. Accordingly it is not possible to determine the sensitivity to ageing of plastics bottle crates based on such characteristic values.

The present invention has arisen from attempts to provide a method and apparatus by which the strength of a plastics bottle crate can be determined rapidly and reliably and which in particular makes it possible to determine accurately when the ageing of the crate has reached such a point that it should be withdrawn from circulation.

According to the invention there is provided a method of determining the strength of crates made of plastics and having handles, in which at least one of the handles of the crate is subjected to mechanical loading and the magnitude of the mechanical load exerted on the handle forms a measure of the strength of the crate.

In this specification, a reference to determination of the strength of a plastics crate is intended to mean determination of its sensitivity to ageing, i.e. the sensitivity to breakage due to embrittlement.

On the one hand, the method makes it possible to perform a non-destructive test on usable crates, and on the other hand, handles which are liable to break may, if desired, be completely destroyed so that defective crates are always rendered unusable, an important point from the accident prevention point of view.

The handle may be mechanically loaded by being subjected to torsional forces or hammer blows, but preferably the mechanical loading is achieved by bending the handle inwards and/or outwards.

The invention also provides an apparatus for carrying out the method, comprising clamping means for clamping a crate to be tested, and a bending force generator which is mounted on a vertically movable slide to enable the force generator to be moved in and out of engagement with the handles to be mechanically loaded.

The clamping means preferably comprises a pair of clamping devices of which each includes a ram and piston rod arrangement.

The invention includes an installation for determining the strength of crates made of plastics material and having handles, including the apparatus referred to above, a crate conveyor, and a table, located alongside the conveyor, on which the crate is clamped by the clamping means to enable the handles to be mechanically loaded by the bending force generator.

Further features of the invention will be apparent from the following description.

The invention is described below, by way of example only, with reference to the accompanying diagrammatic drawings, in which;

Figure 1 is a plan view of an installation for testing the strength of bottle crates carried on a bottle crate conveyor, and

Figure 2 is a partially sectioned side elevation of the installation of Figure 1 but with half of the equipment, including one of the bending force generators, omitted.

Bottle crates 1 to be tested are carried on a conveyor belt 2, with their longer sides extending in the direction of travel. The conveyor belt 2 can, for example, be arranged between the unloading and loading stations of a machine for unloading empty bottles and for loading filled bottles into the crates.

Each crate 1 is made of plastics. Hand holes 3 (Figure 2) are provided in all four side walls of each crate, so that handles 4 and 5 are formed extending along the upper edge of each side wall, a handle 4 being present on each of the longer

sides and a handle 5 on each of the shorter sides.

To one side of the belt 2 is a table 6 which is rotatable about a vertical axis. On diametrically opposite sides of the table 6 are located respective support frames 7, each having a respective bending force generator 8 for bending the handle on one longer side of a crate. On each of the frames 7 there is also a device 9 for clamping to the table 6 a crate 1 under test. The two frames 7 extend substantially parallel to the belt 2.

On the opposite side of the belt 2 is a pusher 10, movable in a direction which is transverse to the conveyor belt 2, towards the axis of rotation of the table 6. The table 6, or rather its upper surface, and the belt 2 lie in substantially the same horizontal plane so that the pusher 10 can displace a crate 1 to be tested from the belt 2 on to the table 6, to a position between two stops 11 on the table 6, when the table 6 is in a position which is angularly displaced through 90° from the position illustrated in Figure 1. The pusher 10 is actuated by a hydraulic ram 12. The spacing between the stops 11 is adjustable to suit the length of the particular crates to be tested. Both stops 11 are at the same distance from the axis of the table 6, and their inner sides are convex.

Each of the two supporting frames 7 comprises a base plate 13 and a console 14 mounted on the base plate. Between the base plate 13 and the console 14 extend two vertical supporting columns 15 on the side of the frame 7 which is furthest from the table 6, and two vertical mutually parallel guide plates 16 and 17 on the side of the frame 7 which is nearest to the table 6.

A slide plate 18 is slidably guided so as to be vertically movable, between the two guide plates 16 and 17 of each frame 7. Movement of the slide plate 18 is achieved by the piston rod (not shown in the drawings) of a hydraulic ram 19 which is secured to the console 14.

Each bending force generator 8 is mounted on the slide plate 18. and comprises a hydraulic ram 20 having a piston rod 21 which is movable back and forth horizontally in a direction towards and away from the axis of the table 6. On its end which is furthest from the ram 20, the piston rod 21 has a fork 22 which opens downwards in order to be placed over and so engage a handle 4 on the crate 1, in fact at about the mid-length of this handle 4. Each force generator 8 is secured to the slide plate 18 by a flange 23 on the ram 20.

Each clamping device 9 comprises a hydraulic ram 29 of which the piston rod 24 is horizontally movable in the same vertical plane as the piston rod 21 of the force generator 8. The two rams 29 are each mounted on the base plate 13 of one or other of the support frames 7, so that their piston rods 24 each contact the adjacent side wall of a crate 1 on the table 6, near the base of the crate, at about the mid-length of the respective side wall, thus clamping the crate in position on the table 6.

Each frame 7 has, on the side which is furthest from the belt 2, a horizontal arm 25 which extends away from the belt 2. A transverse beam 26 is mounted between the two arms 25 so as to be rotatable about the axis of the rod, which lies parallel to the piston rods 21 of the force generators 8. The distance between the beam 26 and the level of the upper surface of the table 6, is greater than the height of the crates 1 to be tested. A further pusher 27 is mounted on the beam 26 and is actuated by a hydraulic ram 28. The pusher 27 can be pivoted upwards away from the position shown in Figure 2 by rotation of the beam 26.

The apparatus operates as follows:

The table 6 is turned, to receive a bottle crate 1 to be tested, to the position in which the stops 11 are adjacent to the frames 7, i.e. to a position displaced 90° from that shown in Figure 1. The pusher 27 on the beam 26 is pivoted away from the position shown in Figure 2 into its upper position.

The crate to be tested which lies on the conveyor belt 2, is displaced by the pusher 10 from the belt 2 to a position between the stops 11 on the table 6, as soon as the middle of its longer side arrives opposite to the pusher 10. The crate 1 comes to rest on the table 6.

If only sampling tests are to be made, then for example only every tenth crate is tested, i.e. is shifted by the pusher 10 from the belt 2 onto the table 6.

The table 6 is then turned through 90°. The piston rods 24 of the clamping devices 9 are extended, centralising the crate 1 on the table 6 and clamping it there. The two slide plates 18 are then moved downwards until the forks 22 on the piston rods 21 of the force generators 8 engage over the middles of the handles 4 on the two longer sides of the crate 1.

The rams 20 now perform at least one working stroke, causing the handles 4 on the two longer sides of the crate 1 to be deflected inwards and outwards from their starting positions (shown in full lines in Figure 1) between the positions indicated by the broken lines in Figure 1. The maximum displacement on inward and outward movement of each handle 4 is preferably 10 to 30% of the length of the handle 4.

If a handle 4 on the crate 1 is unable to withstand the maximum displacement 'l', that is to say, if it breaks, the piston rods 24 are retracted and the clamping devices 9 release the crate 1. Then the pusher 27 on the beam 26 is swung down from its upper position so as to engage a shorter side wall of the crate 1. The crate 1 with the broken handle 4 is then ejected from the equipment by the pusher 27, and discarded. Subsequently the pusher 27 on the beam 26 is swung upwards again and the table 6 is turned back through 90° into its receiving or starting position.

If however neither of the handles 4 breaks, the slides 18 are moved upwards by the rams 19, whereupon the clamping devices 9 release the crate 1 and the table 6 is turned back through 90° to its starting position. Then the pusher 27 on the beam 26 is swung down towards the crate 1 in

order to push the crate 1 back into the belt 2, where it continues its journey, for example to a loading station at which it is filled with bottles. Finally the pusher 27 is swung back up again.

In order to carry away the crates 1 which have been discarded from the table 6 by the pusher 27, a further crate conveyor can be provided, such as a conveyor belt, arranged on the opposite side of the table 6 from the conveyor belt 2 and extending substantially perpendicular to the conveyor belt 2.

The pusher 27 could be in the form of a gripper which grasps the handle 5 and is actuated by the ram 28. With this version, the beam 26 would be capable of swinging through about 180°, in order to lift the crate 1 held by the gripper over the beam 26 and onto the above-mentioned further conveyor, the gripper being rotatably mounted on the beam 26 so that the crate 1 can be placed on the further conveyor with its base downwards.

In order to indicate whether one of the handles 4 of the crate 1 has broken, each piston rod 21 can comprise two relatively slideable parts, for example telescoping relative to one another, spring-loaded away from one another with sufficient force to allow the above-mentioned displacement 'l' of each handle 4 to take place. In this case an electric switch can be provided, actuated by the part of the piston rod 21 which is nearer to the table 6, as soon as this part moves towards the interior of the crate 1 beyond the displacement 'l'. The switch could be arranged to cause the clamping devices 9 to release the crate 1 and the pusher 27 to swing down and push the crate with the broken handle out of the equipment.

Instead of piston rods 21 being made up of two relatively displaceable parts, each ram 20 could be in the form of a pneumatic ram and the electric switch could be arranged so that it is actuated when the associated piston rod 21 moves rapidly beyond the normal displacement 'l', on breakage of the handle 4.

CLAIMS

1. A method of determining the strength of crates made of plastics and having handles, in which at least one of the handles of crate is subjected to mechanical loading and the magnitude of the mechanical load exerted on the handle forms a measure of the strength of the crate.

2. A method according to Claim 1, in which the mechanical loading is achieved by bending the handle inwards and/or outwards.

3. A method according to Claim 1, in which the handle is mechanically loaded by being subjected to torsional forces or hammer blows.

4. A method according to one of Claims 1 to 3, in which the bending force or torsional forces or the hammer blows are applied to the handle at its mid-length or thereabouts.

5. A method according to one of Claims 1 to 4, in which the crate has handles of different lengths and the longest handle is subjected to the mechanical loading.

6. A method according to Claim 2, in which the maximum displacement of the handle during mechanical loading is 10 to 30% of the length of the handle.

7. An apparatus for carrying out a method according to one of Claims 1, 2, 4, 5 and 6, comprising clamping means for clamping a crate to be tested, and a bending force generator which is mounted on a vertically movable slide to enable the force generator to be moved in and out of engagement with the handles to be mechanically loaded.

8. An apparatus according to Claim 7, in which the bending force generator comprises a ram of which the piston rod is movable horizontally back and forth in order to bend the handle of the crate.

9. An apparatus according to Claim 8, in which the piston rod has a fork to engage the handle.

10. An apparatus according to one of Claims 7 to 9, in which the slide is in the form of a plate which is guided between two vertical parallel guides.

11. An apparatus according to Claim 10, in which the two guides extend between a base plate and a console arranged above the base plate, of a support frame.

12. An apparatus according to one of Claims 7 to 11, in which the slide is actuated by a ram.

13. Apparatus according to Claim 12 as appended to Claim 11, in which the ram which actuates the slide is mounted on the console.

14. Apparatus according to Claim 8, in which the ram of the bending force generator is secured to the slide by a flange on that ram.

15. An apparatus according to Claim 8, in which the clamping means comprises a pair of clamping devices of which the clamping parts are movable back and forth parallel to the piston rod of the ram of the bending force generator.

16. An apparatus according to Claim 15, in which the clamping devices each comprise a ram.

17. An apparatus according to claim 16, in which the rams of the clamping devices are each mounted on the base plate of a support frame.

18. An apparatus according to one of Claims 8 to 17 in which the ram of the bending force generator, the ram which actuates the slide and/or the rams of the clamping devices are hydraulic.

19. An installation for determining the strength of crates made of plastics material and having handles, including an apparatus according to one of Claims 7 to 18, a crate conveyor, and a table, located alongside the conveyor, on which the crate is clamped by the clamping means to enable the handle to be mechanically loaded by the bending force generator.

20. An installation according to Claim 19, in which the table and the conveyor lie in a common plane, and the installation includes a pusher, movable back and forth transverse to the direction of travel of the conveyor, by which the crates to be tested can be displaced from the conveyor onto the table.

21. An installation according to Claim 19 or 20 as appended to Claim 16, including two bending

force generators for mechanically loading handles formed on opposite sides of a crate, in which the table is a rotary table, and one bending force generator and one clamping device are arranged on each side of the table in such a way that the piston rods of the two bending force generators and the piston rods of the two clamping devices extend towards the axis of rotation of the table and substantially parallel to the direction of travel of the conveyor.

22. An installation according to one of Claims 19, 20 and 21, which includes a further pusher by which tested crates are returned to the conveyor from the table or, in the event of the handle being broken by the force generator, are ejected from the table and discarded.

23. An installation according to Claim 22, in which a further conveyor is provided for carrying away the discarded crates from the table.

24. An installation according to Claim 20 or 22, in which the or each pusher is actuated by a hydraulic ram.

25. An installation according to one of Claims 22 and 23, in which the further pusher is mounted on a transverse beam and is capable of being pivoted upwards about a horizontal axis.

26. An installation according to one of Claims 19 to 25, in which adjustable stops are arranged on the table for positioning the crate.

27. An installation according to one of Claims 19 to 26, installed between the unloading station and the loading station of a machine for unloading empty bottles and for loading filled bottles into crates.

28. A method of determining the strength of crates made of plastics and having handles, which is substantially as described with reference to the accompanying drawings.

29. An apparatus for determining the strength of crates made of plastics and having handles, which is substantially as described with reference to the accompanying drawings.

30. An installation for determining the strength of crates made of plastics and having handles, which is substantially as described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1981. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.